



Appendix A to Appendix IX-Statistics

A.1 Determination of Enrichment Factor

After at least 10 initial emissions tests are performed, an enrichment factor for each metal must be determined. At the 95% confidence level, the enrichment factor, $EF_{95\%}$, is based on the test results and is statistically determined so there is only a 5% chance that the enrichment factor at any given time will be larger than $EF_{95\%}$. Similarly, at the 99% confidence level, the enrichment factor, $EF_{99\%}$, is statistically determined so there is only a 1% chance that the enrichment factor at any given time will be larger than $EF_{99\%}$.

For a large number of samples ($n > 30$), $EF_{95\%}$ is based on a normal distribution, and is equal to:

$$EF_{95\%} = EF + z_c \sigma \quad (1)$$

where:

$$\overline{EF} = \frac{\sum_{i=1}^n EF_i}{n} \quad (2),$$

For a 95% confidence level, z_c is equal to 1.645.

For a small number of samples ($n < 30$), $EF_{95\%}$ is based on the t - distribution and is equal to:

$$EF_{95\%} = EF + t_c S \quad (4)$$

where the standard deviation, S, is defined as:

$$\sigma = \left[\frac{\sum_{i=1}^n (EF_i - \overline{EF})^2}{n} \right]^{1/2} \quad (3)$$

$$S = \left[\frac{\sum_{i=1}^n (EF_i - \overline{EF})^2}{n - 1} \right]^{1/2} \quad (5)$$

t_c is a function of the number of samples and the confidence level that is desired. It increases in value as the sample size decreases and the confidence level increases. The 95% confidence level is used in this method to calculate the "violation" kiln dust metal concentration limit; and the 99% confidence level is sometimes used to calculate the "conservative" kiln dust metal concentration limit. Values of t_c are shown in table A-1 for various degrees of freedom (degrees of freedom = sample size-1) at the 95% and 99% confidence levels. As the sample size approaches infinity, the normal distribution is approached.

A.2 Comparison of Enrichment Factor Groups

To determine if the enrichment factors measured in the quarterly tests are significantly different from the enrichment factors determined in the initial Step 2 tests, the t-test is used. In this test, the value t_{meas} :

$$t_{meas} = \frac{\overline{EF_1} - \overline{EF_2}}{\sigma_t \left(\frac{1}{n_1} + \frac{1}{n_2} \right)^{1/2}} \quad (6)$$

TABLE A-1.-T-DISTRIBUTION

n-1 or n ₁ + n ₂ -2	t _{.95}	t _{.99}
1	6.31	31.82
2	2.92	6.96
3	2.35	4.54
4	2.13	3.75
5	2.02	3.36
6	1.94	3.14
7	1.90	3.00
8	1.86	2.90
9	1.83	2.82
10	1.81	2.76
11	1.80	2.72
12	1.78	2.68
13	1.77	2.65
14	1.76	2.62
15	1.75	2.60
16	1.75	2.58
17	1.74	2.57
18	1.73	2.55
19	1.73	2.54
20	1.72	2.53
25	1.71	2.48
30	1.70	2.46
40	1.68	2.42
60	1.67	2.39
120	1.66	2.36
∞	1.645	2.33

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$$\sigma_t = \left(\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \right)^{1/2} \quad (7)$$

is compared to t_{crit} at the desired confidence level. The 95% confidence level is used in this method. Values of t_{crit} are shown in table A-1 for various degrees of freedom (degrees of freedom $n_1 + n_2 - 2$) at the 95% and 99% confidence levels. If t_{meas} is greater than t_{crit} , it can be concluded with 95% confidence that the two groups are not from the same population.

A.3 Rejection of Data

If the concentration of any hazardous metal in the "required" kiln dust sample exceeds the kiln dust metal concentration limit, the "spare" samples are analyzed. If the average of the combined "required" and "spare" values is still above the limit, a statistical test is used to decide if the upper value can be rejected.

The "Q-test" is used to determine if a data point can be rejected. The difference between the questionable result and its neighbor is divided by the spread of the entire data set. The resulting ratio, Q_{meas} , is then compared with rejection values that are critical for a particular degree of confidence, where Q_{meas} is:

$$Q_{meas} = \frac{DMC_{highest} - DMC_{next\ highest}}{DMC_{highest} - DMC_{lowest}} \quad (8)$$

The 90% confidence level for data rejection is used in this method. Table A-2 provides the values of Q_{crit} at the 90% confidence level. If Q_{meas} is larger than Q_{crit} , the data point can be discarded. Only one data point from a sample group can be rejected using this method.

TABLE A-2.-CRITICAL VALUES FOR USE IN THE Q-TEST

n	Q_{crit}
3	0.94
4	0.76
5	0.64
6	0.56
7	0.51
8	0.47
9	0.44
10	0.41

NOTE: Authority cited: Sections 25150, 25159, 25159.5, 25245, 58004 and 58012, Health and Safety Code.
Reference: Sections 25159 and 25159.5, Health and Safety Code; and 40 CFR part 266, Appendix IX.

HISTORY

1. New appendix filed 7—1—96; operative 7—31—96 (Register 96, No. 27).
2. Change without regulatory effect amending appendix IX filed 6—12—97 pursuant to section 100, title 1, California Code of Regulations (Register 97, No. 24).
3. Repealed and new section 3.0 and repealer of sections 3.1—3.6.9.4 filed 10—13—98; operative 11—12—98 (Register 98, No. 42).